Table of Contents

Utah System of Higher Education
Operations, Maintenance and Programming Costs
June 14, 2005

Introduction

This report addresses the following category of expenses: Operation and Maintenance (O&M), fuel and power and programmatic costs as they relate to Legislative policy and procedures for funding new buildings in the Utah System of Higher Education (USHE).

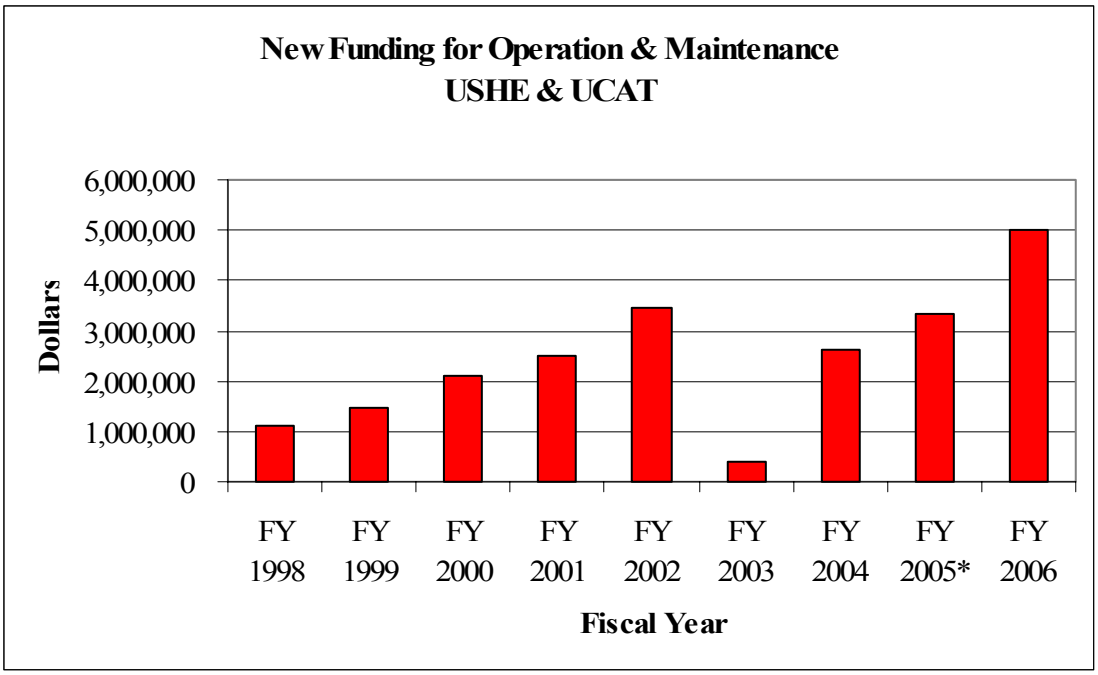
For purposes of clarification the following definitions for O&M components are provided. A more detailed definition of O&M services is provided in Appendix A following this report:

- **Maintenance and repair** includes the cost for preventative maintenance, programmed painting and carpet replacement, repairs that extend a system's life expectancy but generally do not increase its capacity, and unscheduled and unanticipated service calls where an emergency response might be necessary.

- **Operations** includes: facilities administration and staff to oversee and support facilities operations including scheduling, accounting, support functions, custodial services, landscape services, security services, waste removal services, environmental health and safety services, utility infrastructure services and water and sewer services.

- **Fuel and Power** deals with the building power systems and central energy plants.

Over the years, it has been the practice of the Legislative Higher Education Appropriations Subcommittee to appropriate the cost of operating and maintaining (O&M) new "State Funded" facilities when the Legislature approves the capital development projects. O&M costs in higher education have grown more than 5 times from the $1.1 million appropriated in FY 1998 to the $5.0 million appropriated for FY 2006. Historical funding of Operating and Maintenance costs for the Utah System of Higher Education (USHE) and the Utah College of Applied Technology (UCAT) is illustrated in the following graph:

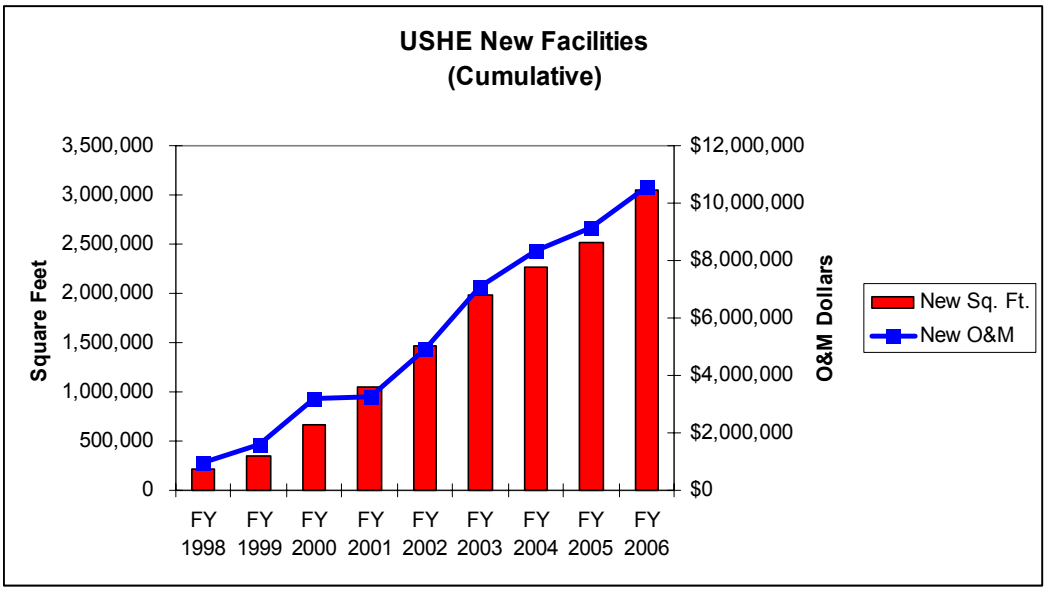


* Includes $2.4 million absorbed in institutional budgets and $0.9 million in 1-time supplemental.

The challenge for the Higher Education Appropriation Subcommittee is the need to fund O&M, when the approval for the construction or purchase of facilities was rendered by the Capital Facilities and Administrative Services Appropriations Subcommittee. The Higher Education Subcommittee felt obligated to provide for the annual cost to maintain and operate the buildings.

O&M Funding Formula

O&M funding requirements for new facilities is adopted by the Capital Facilities Subcommittee at the time the project is approved for funding. The direct correlation in the growth in new square feet and the amount of additional O&M funding approved by the Legislature for USHE capital development projects is portrayed in the following chart.



There is a timing differential in the actual funding of O&M by the Higher Education Appropriation Subcommittee. This issue became a discussion of great interest because of limited State resources and multiple funding needs requiring attention during the 2004 General Session. It was during this time that the facilities authorized for construction several years earlier by the Capital Facilities subcommittee were ready for occupancy and O&M funding. The O&M for those facilities coupled with the unfunded O&M from the prior fiscal year totaled about $2.4 million. The Higher Education Subcommittee, unable to obtain sufficient resources to fund the O&M costs due to limited State resources, required that USHE institutions absorb these costs out of current operating funds.

For the 2005 General Session, the Legislature funded O&M cost increases associated with the approval to construct, remodel or add additional square footage to a facility. To better match appropriated O&M funds with building occupancy, the Legislature appropriated ongoing funds coupled with an offsetting negative one-time appropriation to account for partial year occupancy of the facility. The intent of this decision was to ensure that O&M be fully funded in the base budget. This mechanism will also provide continuous O&M funding in the base budget when future construction of capital development projects are completed.

The Fiscal Analyst's Office will track construction progress and recommend additional one-time adjustments as needed until the facilities are fully occupied.

Computing the Cost to Operate and Maintain New Facilities

The funding model for determining the request for Operations and Maintenance (O&M) of higher education capital projects was adopted by the Board of Regents on May 30 2003 and then by the Building Board on June 4, 2003.

The O&M funding model recognizes the different uses of each facility and computes the costs accordingly. This includes the following cost categories:

- Classroom and Administrative or Faculty Office Space
- Library or Student Activity Center
- Campus Shop and Service Center or Vocational Classroom/Lab
- Physical Education Facility
- Laboratory

It is noted that a full description of each building type in included in the appendix at the end of this report.

To compute the O&M costs for each facility, the Building Board and the Regents use the Current Replacement Value (CRV) as the base for deriving the cost for maintenance, repairs and operating expenses on each building. In the case of a new facility, the CRV is the estimated cost of construction to calculate O&M costs. A "per-square-foot" cost factor is determined as percentages of the current replacement value of the capital asset for each of the five different functional purposes.

Fuel and power costs are determined based on standard costs per square foot for each space type programmed for the new facility.

Within each building cost center, the amount for: a) Maintenance and Repair, b) Operating Expenses and c) Fuel and Power are used to compute the total expense. For purposes of illustration, the computation for the O&M dollars requested for the Snow College library/classroom addition is shown in the following table:

SNOW COLLEGE

Classroom Building O&M Calculation

For Consideration in the 2006 General Session

		Maintenance/ Repair	**Opertions**	**Fuel & Power**	**Total**	**Dollars Requested**
Classroom/Office						
Standard Formula Factors		0.0130	0.0095	$1.40		
Current Replacement Value	$4,708,200					
Gross Square Feet	30,000	$2.04	$1.49	$1.40	$4.93	$147,700
CRV per GSF	$156.94					

To continue this illustration the total O&M cost for the new facilities to be considered at Snow College and at Utah State University is shown below:

SNOW COLLEGE

Library/Classroom Building

O&M Fund Request for Consideration in the 2006 General Session

Type of Space	CRV	GSF	M&R	OPS	Fuel & Power	Total	Total O&M Cost
Classroom/Office	$4,708,200	30,000	$2.04	$1.49	$1.40	$4.93	$147,700
Libraries/Student Centers	$10,358,000	66,000	$2.28	$1.49	$1.40	$5.17	$341,200
Service/Shop/Vocational						$0.00	$0
Physical Education						$0.00	$0
Laboratories						$0.00	$0
Total O&M Cost	$15,066,200	96,000					$488,900
Existing O&M Funding							0
Net O&M Funding							$488,900

It is noted that requests for renovation or replacement O&M funding is reduced by existing funding levels. This is shown in the following illustration for the proposed USU Agriculture Science building:

UTAH STATE UNIVERSITY

Agriculture Science Classroom

O&M Fund Request for Consideration in the 2006 General Session

(Replacement Facility)

Type of Space	CRV	GSF	M&R	OPS	Fuel & Power	Total	Total O&M Cost
Classroom/Office	$36,927,700	200,000	$2.40	$1.75	$1.40	$5.55	$1,110,000
Libraries/Student Centers						$0.00	$0
Service/Shop/Vocational						$0.00	$0
Physical Education						$0.00	$0
Laboratories	$9,231,900	50,000	$2.50	$1.75	$2.80	$7.05	$352,500
Total O&M Cost	$46,159,600	250,000					$1,462,500
Less: Existing O&M Funding							343,500
Net O&M Funding							$1,119,000

Funding for certain kinds of routine or unscheduled repairs is included in the O&M funding formula. Major repairs are handled outside of the O&M process through the Capital Improvements process.

Capital Improvements funding is appropriated annually to DFCM for allocation to projects by the Building Board, although the Legislature reserves the right to designate projects to be funded.

Capital Improvements are defined by statute as any remodeling, alteration, replacement, or repair project with a total cost of less than $1,500,000; site and utility improvements with a total cost of less than $1,500,000; or a new facility with total construction costs of less than $250,000 (UCA 63A-5-104).

While no clear line exists between repair projects that should be funded with O&M dollars versus Capital Improvement dollars, the Building Board has adopted definitions and policies. Under these policies, repair projects to be funded with O&M dollars include what would be considered routine or unscheduled repair and replacement of existing systems, and scheduled maintenance required to achieve full system life expectancy and optimum reliability. Repair projects to be funded with Capital Improvement dollars include substantial repairs to building systems and components beyond that included in the definition of operations and maintenance.

As a practical matter, with the state's large maintenance backlog, projects must rise to a high priority level before they will compete favorably for limited Capital Improvement funds. For further information, please refer to the definition of terms in Appendix A at the end of this report.

Anticipated Future Construction and O&M Requests

The following table displays a list of higher education buildings and the O&M approved during the 2005 General Session. The following table also includes a list of anticipated requests for the 2006 General Session and potential building requests for later sessions of the Legislature.

It is not likely that every project reflected in this list will be funded during the 2006 General Session. In all probability many of these projects will repeat in future requests and may even bump other requests further down the list.

Higher Education Capital Developments

Funded in 2005 General Session

Institution	Project	Authorized State Funds	Other Funding	State Funded O&M Incr.	Square Feet	New FTE Required	Add'l Program-ming Costs
DSC	Health Sciences Building	$15,743,000	$2,582,500	$413,100	67,000	5	$5,600,000
U of U	Marriott Library Renov/ASRS	$48,023,000	$22,700,000	$480,000	316,600	0	$200,000
U of U	Museum of Fine Arts	$465,000	$0	$0	0	0	$0
SUU	Teacher Education Building	$10,000,000	$0	$242,500	48,000	0	$0
BATC	Purchase Bourns Building	$3,585,500	$0	$296,800	87,700	2	$120,000
Total		$77,816,500	$25,282,500	$1,432,400	519,300	7	$5,920,000

Anticipated 2006 General Session Requests

Institution	Project	Est Request State Funds	Est Other Funding	Estimated O&M Incr.	Square Feet	New FTE Required	Add'l Program-ming Costs
UVSC	Digital Learning Center	$37,750,000	$0	$955,700	181,500	4	$180,000
USU	Agriculture Bldg Replacement	$57,237,000	$0	$1,119,800	250,000	0	$0
WSU	Bldgs #1 and #2 Replacement	$21,001,000	$0	$233,800	78,000	3	$0
SLCC	Millcreek Center	$6,000,000	$0	$219,000	60,000	5	$0
Snow	Library/Classroom Bldg	$14,237,000	$5,100,000	$488,900	96,000	2	$0
UBATC/USU	Vernal Campus Bldg	$10,788,000	$2,697,100	$333,700	66,600	8	$460,000
USU	Relocate Farm Buildings	$5,000,000	$0	$0	0	0	$0
Total		$152,013,000	$7,797,100	$3,350,900	732,100	22	$640,000

Anticipated Out-Years General Session Requests

Institution	Project	Est Request State Funds	Est Other Funding	Estimated O&M Incr.	Square Feet	New FTE Required	Add'l Program-ming Costs
DSC	Whitehead Student Service Ctr	$14,000,000		$0	60,000		
U of U	Orson Spencer Hall Renov	$24,000,000		$150,000	116,000		
DATC	Davis ATC High Tech Bldg	$13,000,000		$425,000	85,000	6	
SLCC	Visual Arts/Design Bldg	$16,000,000		$425,000	85,000	4	$80,000
SUU	Business Bldg Addition	$4,000,000		$100,000	20,000		
MATC	North Utah Co. Campus	$11,000,000		$350,000	75,000		
USU	Health/PE/Rec Renovation	$25,000,000		$540,600	115,000		
UVSC	Student Academic Spt Bldg	$18,000,000	$4,000,000	$503,400	95,500		
WSU	Davis Campus Classrm Bldg	$18,000,000		$360,000	80,000	5	
Total		$143,000,000	$4,000,000	$2,854,000	731,500	15	$80,000

Sources: 2005 General Session Appropriations and DFCM Five Year Book

When state agencies and institutions submit requests to the Division of Facilities Construction and Management (DFCM) they must estimate the "New FTE required" for the new building. However, it is not clear if the new FTE are needed for O&M or programmatic purposes.

Determining Additional Programming Costs

Programming costs refers to the amount of funding needed for faculty, staff or other related expenses associated with providing instruction.

When a new facility is constructed, the anticipated increases in new programmatic costs are not usually funded for the system of higher education. Additional funding for faculty, staff or other related costs come through the "enrollment growth" funding formula. As student enrollment increases, the direct cost of instruction, by type of institution and by level of instruction is computed. If the Legislature fully funds enrollment growth, sufficient resources would be available for USHE institutions to accommodate programmatic increases associated with the addition of new facilities. On the other hand,

if enrollment growth is not fully funded then the deficit will create a shortfall in operating funds at the institution may have to turn away students.

Unlike other higher education institutions, programmatic growth for the Utah College of Applied Technology (UCAT) as shown in the previous table does reflect a request for additional programs in the new facility because they do not have an enrollment funding model to provide programmatic cost increases. It is noted that the USHE funding mechanism will be incorporated to determine enrollment growth funding needs for UCAT in the future.

DFCM in the "Capital Development Project" request for State funded facilities requires State Agencies and the USHE to provide programmatic information and the associated program cost increases for each facility. Typically, USHE interprets this request to mean the additional State resources needed to fund the expansion or the addition of new programs that will be offered in the facilities. Since new enrollment growth revenue, if fully funded, is assumed to be sufficient to fund program costs incurred, USHE usually indicates that no additional programmatic funding is required in their request for a new facility.

As a result, the Analyst asked USHE to respond to the following questions to provide appropriate programmatic information to help identify the costs associated with new facilities, regardless of funding source, a new facility adds to campus operating costs.

For example, Dixie State College responded to this request and provided the following information on their new **Health Science Building**, funded in the 2005 general session:

A. What programs will be offered in the new facility?

Program expansion resulting from the construction of the new Health Science Building will require hiring at least 20 additional faculty at Dixie State College. The increase is as follows:

- **Nursing:** DSC will add five new nursing faculty members to allow for expansion from 40 to 200 nursing students in the next academic year.
- **EMT/Paramedic:** Another faculty member will be added in the Emergency Medical Technician/Paramedic program.
- **Surgical Technology:** An additional full-time faculty member will be added to comply with CAAHEP/JCAHO program accreditation.
- **IV Therapy:** As program growth dictates we will add faculty.
- **Dental Hygiene:** The new facilities will allow us to double our production of dental hygienists. We will require additional faculty to support this growth.
- **New programs:**
    - **Bachelor of Science Degree in Nursing:** We have added the faculty to support both the current growth in nursing and this new degree. As we continue to increase the annual number of nursing graduates, we will need additional nursing faculty. The expanded facilities in the new **Health**

Sciences building will allow us to increase the number of nursing graduates yearly for the next five years. We are planning on adding at least two more nursing faculty over the five years, one of whom will be the Director of Clinical Instruction.

- **Associate of Applied Science Degree in Medical Radiograph**y: Two new faculty will be added over the next two years, a program Director and a Clinical Director.
- **Bachelor of Science Degree in Dental Hygiene:** Two additional faculty members will be added over two years.
- **Associate of Applied Science in Respiratory Therapy:** Two additional faculty members will be added, one of whom will be the program director.
- **Associate of Science Degree in Physical Therapy Assisting:** A program Director and one additional faculty member will be added.

B. What will be done with the vacated space that is currently housed in existing facilities on campus?

Three years ago the health science programs were housed in the Jennings Building on campus. The rapid growth in these programs, 500% in the nursing program required several of our health science programs to share space in the Udvar Hazy School of Business. The new Health Science Building will help relieve the over-crowding in the business school and allow for the continued growth in our business and health science programs:

- Support additional growth in our new accounting emphasis within our Bachelor of Science degree in Business Administration.
- Accommodate the new Bachelors of Science in Communications degree program, and
- Provide space for an on-campus student health clinic.

C. How many new Full-time Equivalent (FTE) students will be served?

It is anticipated that 1,292 new FTE students will be enrolled at Dixie State College as a result of adding the new Health Science Building to their campus. Many of the programs are two year offerings so the full complement of new growth will be there at the beginning of the second year. It is projected that new FTE student growth will be as follows:

- 40 students in the medical radiography program.
- 60 students in the respiratory therapy program.
- 112 students in the B.S. degree program in dental hygiene.
- 80 students in the physical therapy assisting program
- 20 students in the IV therapy program,
- 600 students in the Certified Nursing Assistant (CNA) program
- 100 students in the EMT/paramedic program and
- 280 students in the LPN/RN/BSN programs.

D. What are the additional program costs (included program expansion of reclaimed space by other programs) associated with the new facility?

It is estimated that approximately $5.6 million in additional programming costs will be incurred as a result of adding the new Health Science Building on line at Dixie State College. The plan of financing the programmatic cost, if the current enrollment mechanism is employed for computing costs, will include approximately $3.4 million in State resources and $2.2 million from tuition revenue.

The Analyst notes that Dixie State College did not provide information on the additional programs costs from the expansion of reclaimed space. Given sufficient time, DSC would be able to calculate the additional costs. The Analyst believes that programmatic costs are an important component in the evaluation and prioritization of capital development projects.

Evaluation of Existing Facilities

Since new facilities often result in new programmatic costs, it is important to understand the capital development evaluation process. Each year higher education institutions submit their capital development proposals for consideration by the Board of Regents and the State Building Board. Both boards consider existing space in their evaluations of capital development requests. If an existing facility is in poor condition, has life safety issues, or has inadequate space by type (e.g. classroom, labs, offices, study areas, or P.E.), then both boards' reviews give the project a relatively high ranking. This coincides with the Legislature's philosophy of prioritizing replacement or improvement of existing buildings before adding new square footage for new programs. Other factors such as alternative funding sources, cost effectiveness, and criticality of programs may also move a project up or down the rankings.

The Utah System of Higher Education's Qualification and Prioritization (Q&P) Process emphasizes the current space inventory by type, how much space is needed based on standards and projected enrollment, and how well the requested project fills the calculated gap. Additional points are given for life safety and alternative funding sources. The Building Board's Evaluation Guide emphasizes condition of existing assets, program growth, cost effectiveness, and criticality of programs. Neither board uses the evaluation process to replace deliberations which take into account other factors such as the current budget climate and acceptability of certain kinds of projects. However, rarely do the boards deviate from the rankings provided in their evaluation systems.

An example from the 2005 General Session illustrates the way the evaluation systems considered existing space in their prioritizations. The University of Utah (U of U) requested a library renovation and Utah Valley State College (UVSC) requested a new library. UVSC's request scored higher in the Q&P space requirement assessment (Q rank) because it filled the gap between existing space and needed space to meet standards and student growth. The U of U scored lower in the Q rank even though the Q & P

review doesn't count existing space in facilities to be replaced. Yet in the final analyses, the U of U ranked higher because of deficiencies in the current structure, life safety issues in the event of an earthquake, and availability of other funding sources. The following table shows how the two projects scored:

Board of Regents Q&P Process	Q Rank	Q Points	Other Funds	Life Safety	Priority Points	O&M Points	Total Points
UU Marriott Library Renovation	2	48	6	11	25	0	90
UVSC Digital Learning Center	1	50	0	0	25	0	75

Building Board Evaluation	Existing Facilities	Essential Growth	Cost Effective	Improves Program	Program Criticality	Other Funds	Total Points
UU Marriott Library Renovation	11.5	1	10.5	7.3	7.3	3.5	41.1
UVSC Digital Learning Center	0	10	11	8.3	9	1.5	39.8

Ultimately the rankings and recommendations are submitted to the Legislature for final evaluation. After considering the boards' assessments, the budget situation and other non-quantifiable factors, the Legislature approves or denies funding for each request.

Another aspect in evaluating the prioritization is determining effective and efficient space utilization. At times it is valuable to request an outside entity to independently review USHE's space utilization and standards. The last such study was done in 1996 when the Legislature hired Paulien and Associates, a planning consultant, for a comprehensive analysis. The Legislature may wish to fund another comprehensive study in the near future.

Recommendations

The Legislative Fiscal Analyst has four recommendations as follows:

1. The Analyst recommends that the Legislature continue to fund O&M increases simultaneously with capital facility approvals. This will ensure that base budgets contain necessary funding when projects are completed. It will also continue to repair the disconnect between the Capital Facilities Appropriations Subcommittee that approves the construction and funding for new facilities and the Higher Education Appropriations Subcommittee that is responsible for funding operating budgets.

2. As part of the request for DFCM, and ultimately the Legislature, the Analyst recommends that the USHE institution identify the impact a new facility has on institutional operating funds by responding to the following questions when they submit their proposal for a capital development project:
   A. What programs will be offered in the new facility?
   B. What will be done with the vacated space that is currently housed in existing facilities on campus?
   C. How many new FTE students will be served?

D. **What are the additional program costs (including program expansion of reclaimed space by other programs) associated with the new facility?**

3. Because it is not clear if the new FTE requirements reported in the funding request to DFCM are needed for O&M or for programmatic purposes, it is recommended that future FTE figures for O&M and for programmatic purposes be reported separately.

4. It is recommended that the Legislature consider funding another comprehensive space utilization and standards study to aid in the assessment of new facilities required in higher education in the near future.

Appendix A

Definition of Terms

Current Replacement Value

Current replacement value (CRV) is the total cost of construction excluding design fees and furnishings. The CRV does not include value of the property or other site improvements. For new buildings, the Current Replacement Value will be the construction budget for the project. For renovation projects, the Current Replacement Value will be the cost to construct similar space as estimated by DFCM.

Fuel and Power

The utilities required for proper operation of building systems and central energy plants. Fuel and power costs are expected to be adjusted annually to reflect market changes.

Maintenance and Repair Includes:

- **Preventative Maintenance**
  Preventive maintenance is the planned, scheduled periodic inspection, adjustment, cleaning, lubricating, parts replacement, and minor repair of equipment and systems.
- **Programmed Major Maintenance**
  Programmed major maintenance includes those maintenance tasks whose cycle exceeds one year. Examples of programmed major maintenance are painting and similar functions. This may include carpet replacement.
- **Maintenance Repairs or Corrective Maintenance**
  Maintenance repairs are actions taken to restore a system or piece of equipment to its original capacity, efficiency, or capability. Maintenance repairs extend a system's life expectancy but generally do not increase its capacity.
- **Trouble Calls or Service Calls**
  Service calls are requests for system or equipment repairs that, unlike preventive maintenance work, are unscheduled and unanticipated. Service calls generally are received when a system or component has failed. If the problem has created a hazard or involves an essential service, an emergency response might be necessary. Conversely, if the problem is not critical, a routine response is adequate.

Operations Includes:

- **Facilities Administration**
  Leadership and staff to oversee and support facilities operations including work entry, scheduling, cost accounting and related support functions.
- **Custodial Services**
  Custodial services generally include the cleaning of floors and other surfaces, emptying of trash, and care of restrooms.

- **Landscape Services**
  Landscape services generally include the planting and care of trees and annual plants, planting and mowing of lawns, snow removal on walkways and parking areas, and sprinkler system operation.
- **Security Services**
  Security services include the necessary locking of doors etc. to protect the building asset. Law enforcement and parking services are not included in the security services.
- **Non-delegated Project Planning and Engineering Services**
  Planning and engineering services required to administer projects smaller than the level that requires DFCM administration or delegation, and to provide campus coordination for larger projects.
- **Waste Removal Services**
  Waste removal services include the gathering and disposal of solid waste materials.
- **Environmental Health and Safety Services**
  Environmental health and safety services may include the collection and disposal of hazardous materials requiring special disposal processes.
- **Fire Protection Services**
  Fire protection services include the operating and monitoring of sprinkler and alarm systems, maintenance of fire extinguishers, and other associated activities of a campus fire prevention official.
- **Furniture Repair**
  Furniture repair and moving services include activities associated with repairs of non-fixed furniture and appurtenances.
- **Utility Infrastructure Services**
  Utility infrastructure services include the operation of campus utility supply systems such as: central heating plant, central chilled water system, electrical cogeneration system, substation and high voltage distribution system, sewer and water system. Infrastructure system operations also include monitoring and meter reading associated with delivery of the utility to the building or structure.
- **Water and Sewer**
  Water and sewer includes the cost of the utility and is generally provided by others.

Building Types Include:

- **Classroom/Office**
  Classroom/Office buildings generally have sections of office suites, support space, and classrooms. The classrooms often vary in seating capacity and may seat several hundred in the larger lecture rooms. Computer rooms (labs) are also often associated with the classroom type building. This category also includes space that is primarily classrooms and offices but which may include a limited number of labs. Building operating hours vary between 12 and 20 hours, up to six days per week, and are utilized 12 months per year. Effective cooling and heating systems are critical to this type learning and teaching environment.

- **Libraries/Student Centers**
  Libraries and Student Centers usually have large open areas with associated offices, storage, and other miscellaneous spaces. Campus cafeteria and food service facilities are usually located in the Student Centers. Auxiliary operations fund the O&M costs for space they occupy. Hours of operation in this type of buildings may be 20 hours a day, seven days a week. Cooling and heating systems may operate 24/7.

- **Service/Shop/Vocational**
  Service, Shop and Vocational buildings typically have large areas of shop space with high ceilings and several large overhead doors. Some offices and classrooms are usually included in this type of space. Cooling and heating systems in the open shop space are necessary for student and instructor comfort. Often these systems have a high use of energy due to overhead doors and other ventilation equipment. Building occupancy varies between 12 and 18 hours, up to six days a week.

- **Physical Education**
  Physical Education buildings are generally designed with many large rooms and few offices. This category may include activity centers. Heating and cooling systems are normally designed to more moderate standards compared to other building types. Operating hours typically run from 5:00 am to 10:00 pm six days per week.

- **Laboratory Buildings**
  Laboratory buildings are the most complex of all the building types and consume extreme amounts of energy. This type of building is often designed with one or more offices attached to each lab space. Administrative office and support spaces are frequently located in these buildings. Electrical capacity required for research buildings is much larger than other building types. Power usage is high because of the large cooling and heating systems and lab equipment connections. Cooling and heating systems are critical to the operation of research buildings. Air quality standards for lab space require nearly 100 percent make-up air. Higher energy consumption is the trade off for air quality and occupants' health and safety. Often the people doing research in these spaces work into the evenings and weekends.